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APPENDIX TO REPORT ON VARIABLE LEVEL FORECASTS
(Technical Note No. 75)

123970

by

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NB. This paper has not been published. Permission to quote from it must be obtained from the Assistant Director of the above Meteorological Office Branch.

INTRODUCTION

The variable mesh 10-level split semi-implicit octagon model has been rewritten to accommodate a variable number of levels (up to a maximum of 20). Some experiments using 10 to 17 levels have already been described, but at that time difficulties were encountered when trying to run the model

(a) with fewer than 10 levels

(b) with an extra level inserted between 900mb and 1000mb or

(c) with 18 to 20 levels.

Some of these problems have now been overcome (see section on Programming Considerations for details) and this Appendix describes the results of some further experiments.

The gravity wave speeds were computed for various configurations of levels between 10mb and 1050mb. Models with 5 to 20 levels between 100mb and 1050mb give very similar speeds, with 2 modes exceeding 50ms^{-1}. Models with levels in the stratosphere, however, have 3 or 4 modes exceeding 50ms^{-1}. Some results are given in Table 1.

Further Experiments

The following experiments have been done (see also Table 2)

(1) 20 level semi-implicit

(2) 10 level explicit

(3) 9 level explicit

(4) 6 level explicit

The surface pressure and 500mb fields at 3 days are included in this report, together with the corresponding 10 level semi-implicit results and the analysis fields.

The time step for the explicit forecasts was 5 minutes, and for the semi-implicit forecasts was 15 minutes.

Overall the 10-level forecast is not particularly good. The Atlantic low does not deepen sufficiently, and the 6 and 9 level models have developed a spurious low centre to the west of the main centre. The 20 level model is no better than the 10 level model. All models have much the same 500mb fields.

Programming Considerations

Of the 3 problems mentioned earlier in this Appendix, problem (a) was due to programming errors. Several errors have been corrected and explicit forecasts with 6 and 9 levels have been integrated to 6 days. The model, however, will not yet run semi-implicitly with fewer than 10 levels, presumably due to a programming error in the implicit routines (which might mean that the semi-implicit integrations done previously are incorrect).

Problem (c) has been solved and integrations have been done for 18 and 20 levels.

Problem (b) remains. Difficulties appear near the surface, especially in the 1000mb wind field, after 24 hours or so. No programming error could be detected. The surface friction scheme was modified to achieve a linear decrease of friction between the surface and 900mb. However, even with topography, surface friction, surface exchanges and condensation/evaporation all removed, the problem remains. Using the explicit version, the 11-level model (with an extra level at 950mb) blows up after 275 five minute time-steps (almost 24 hours).

A one grid point model was written to test the variable level CONVECT routine for a dry atmosphere. Tests were run for various types of unstable ascent using 6, 9, 10, 11 and 20 levels. Correct adjustment of the temperature profile was obtained in all the cases considered.

PROGRAMS

BFITV is a polynomial fitting routine for the initial data.
The column size is 4x(7x no. of pressure levels + no. of humidity levels + 3) but with a minimum of 320 bytes.

The following combinations of object and load modules have been used.

1. LOAD (JVL8FC)

   used for SI 10 to 20 levels.

2. OBJ (NVLOCTEW, NVLLPLW, NVCALCOL)

   OBJ (VLOCTCV3, VLOMAIN, BVLOCTDF, VLCONST2)

   OBJ (NVLEXPA8, NVLIMPTH, NVLIMPV)

   LOAD (JVL8FC)

   used for SI 6 - 9 levels (blow up!)

3. OBJ (NVIMPUX, NVIMPVX, NVIMPHTX)
   LOAD (JVL8FC)

   used for EX 10 - 20 levels

4. OBJ(NVLOCTEW, NVLLPLW, NVCALCOL)
   OBJ(VLOCTCV3, VLOMAIN, BVLOCTDF, VLCONST2)
   OBJ(NVLEXPA8, NVLIMPTH, NVLIMPV)
   OBJ(NVIMPUX, NNVIMPVX, NVIMPHTX)
   LOAD(JVL8FC)

   used for EX 6 - 9 levels (works)

NUMBER OF LEVELS	PRESSURES	FASTEST GRAVITY WAVE SPEEDS						
10	100 200 300 400 500 600 700 800 900 1000	298	99	47	30			
19	100 150 200 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000	294	93	44	31			
9	100 300 400 500 600 700 800 900 1000	300	114	41	22			
5	100 400 700 900 1000	303	124	40	16	6		
5	200 500 700 900 1000	291	94	26	14	6		
12	10 50 100 200 300 400 500 600 700 800 900 1000	313	180	105	64	45		
11	10 20 30 40 50 100 300 500 700 900 1000	313	158	105	66	48	45	33

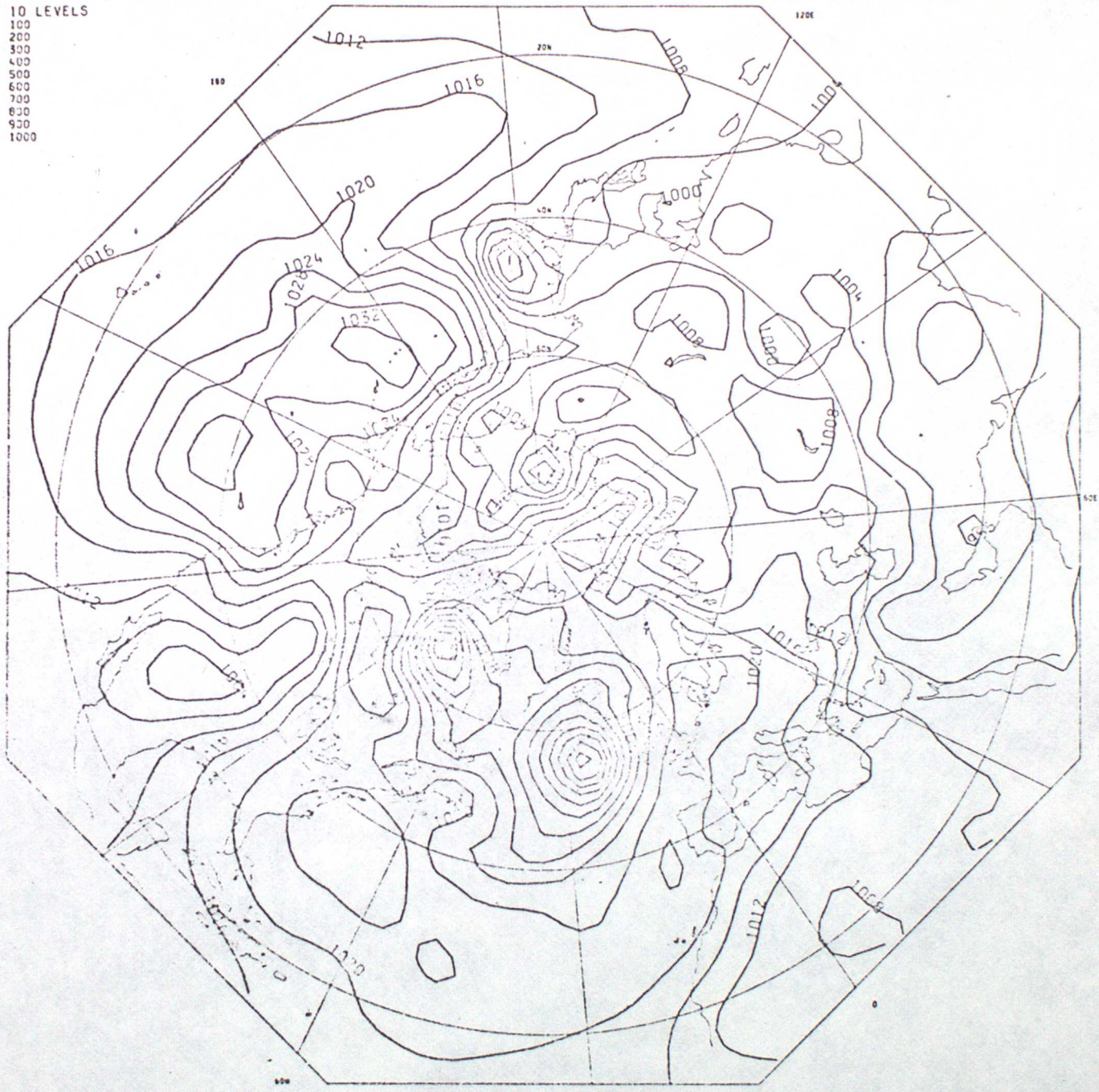
TABLE 1

EXPERIMENT	NUMBER OF PRESSURE LEVELS	LIST OF PRESSURE LEVELS																			
1	20	100	150	200	250	300	350	400	430	470	500	530	570	600	650	700	750	800	850	900	1000
2	10	100	200	300	400	500	600	700	800	900	1000										
3	9	100	300	400	500	600	700	800	900	1000											
4	6	100	300	500	700	900	1000														

TABLE 2

SURFACE PRESSURE FIELD

0 HR.FORECAST. DATA TIME 12 Z 23 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76

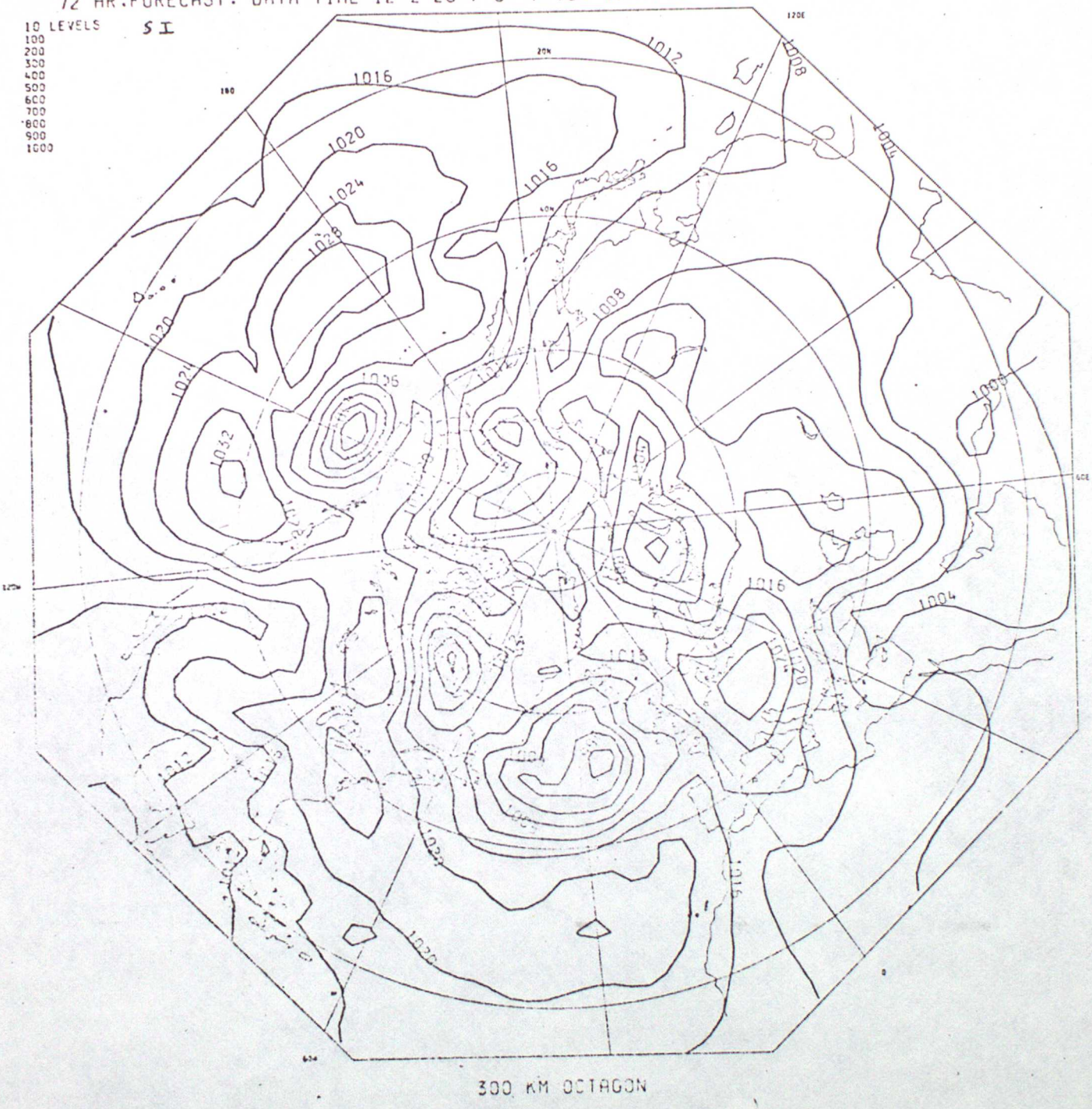


300 KM OCTAGON

DAY 3 ANALYSIS

SURFACE PRESSURE FIELD

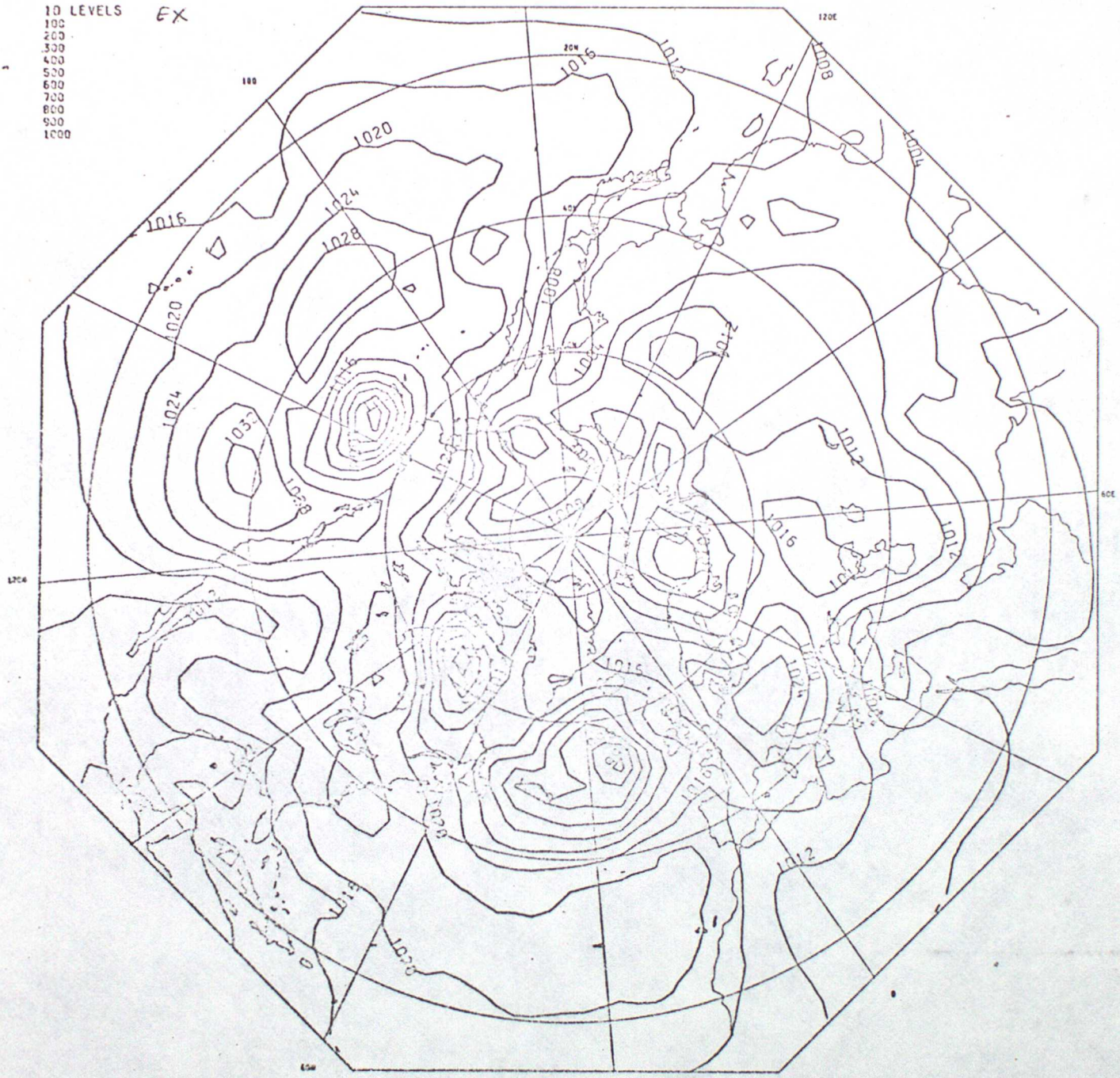
72 HR.FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76



10 LEVEL SEMI-IMPLICIT

SURFACE PRESSURE FIELD

72 HR. FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76

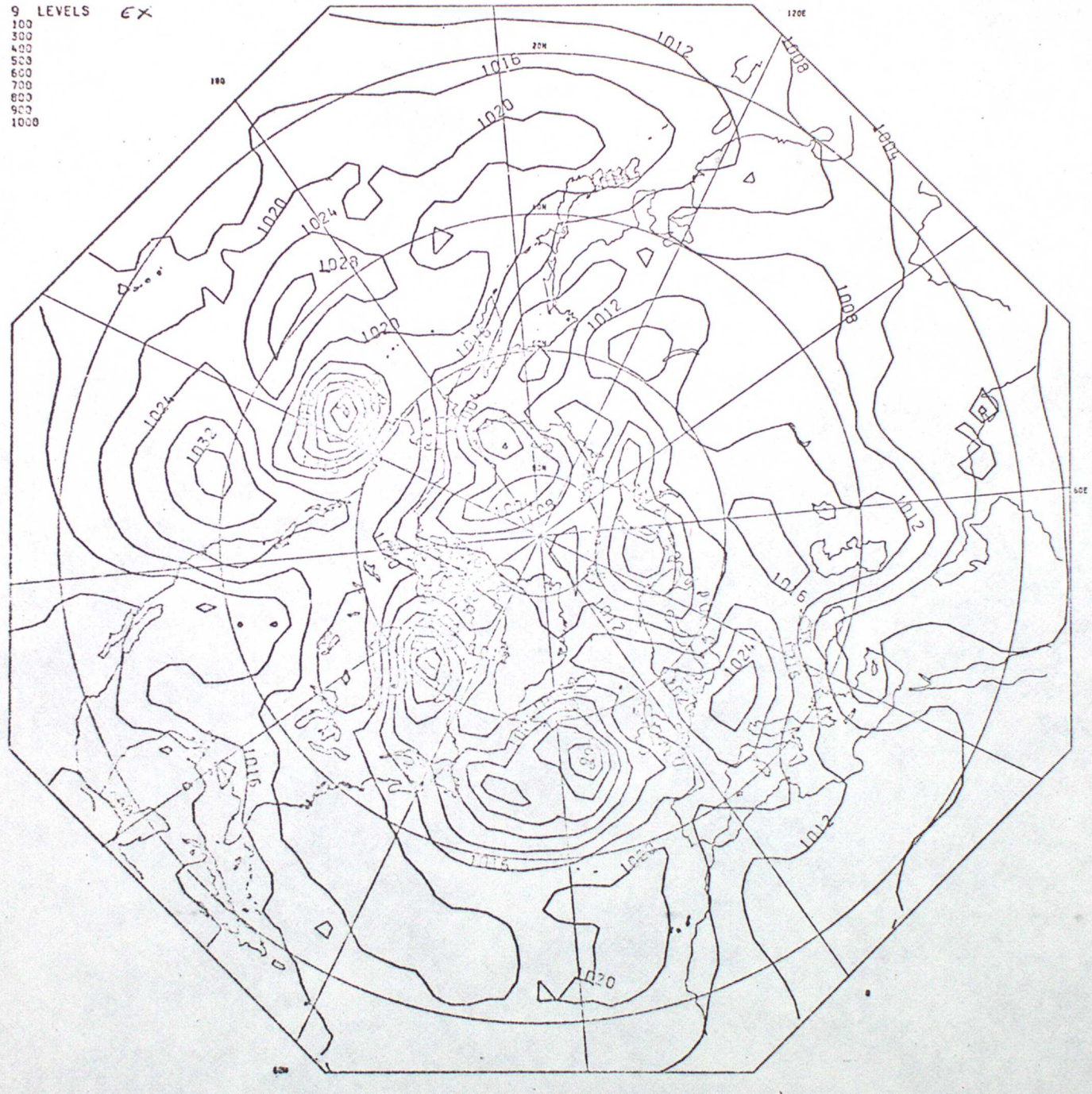


300 KM OCTAGON

10 LEVEL EXPLICIT

SURFACE PRESSURE FIELD

72 HR.FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76

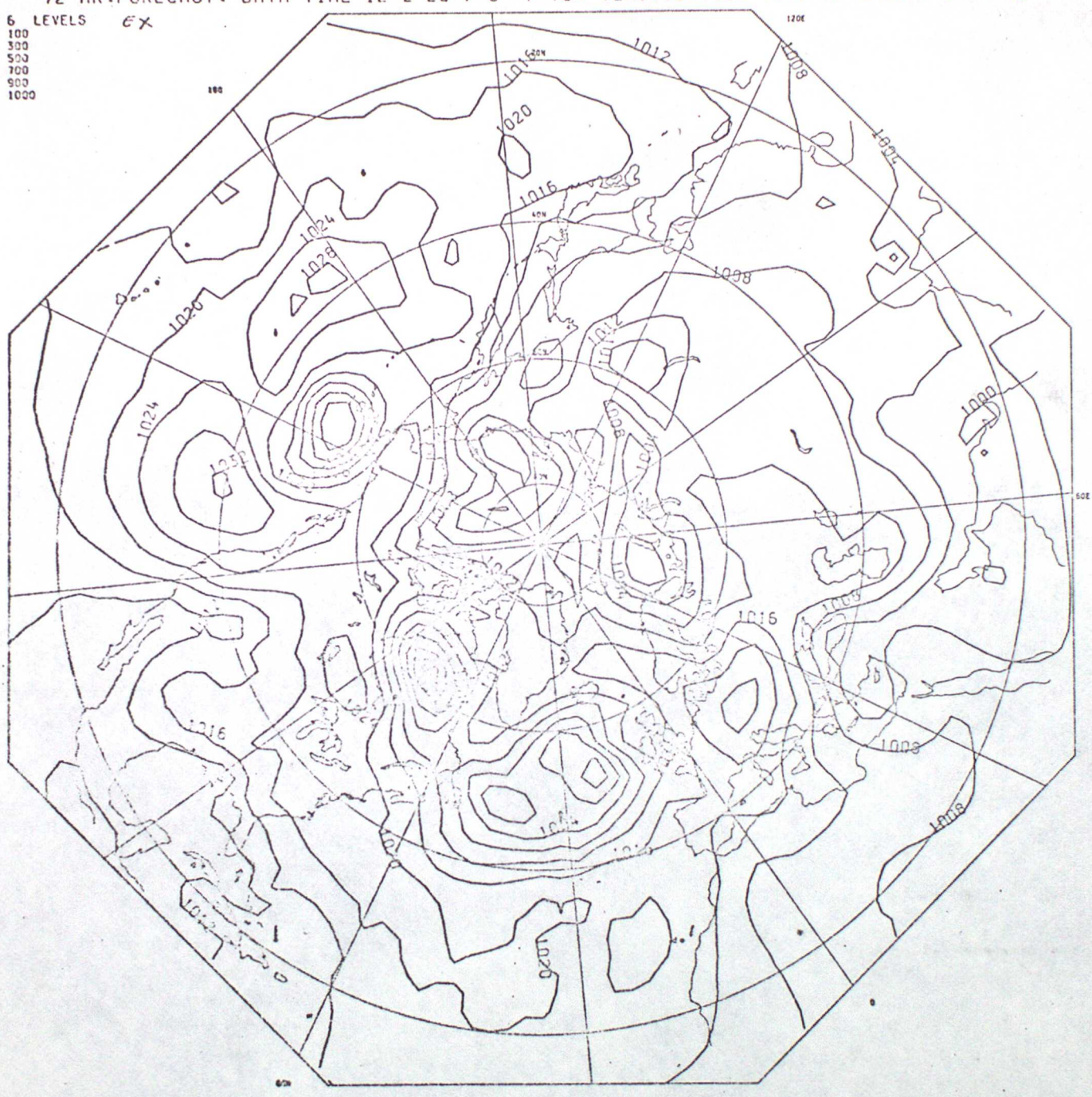


300 KM OCTAGON

9 LEVEL EXPLICIT

SURFACE PRESSURE FIELD

72 HR. FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76

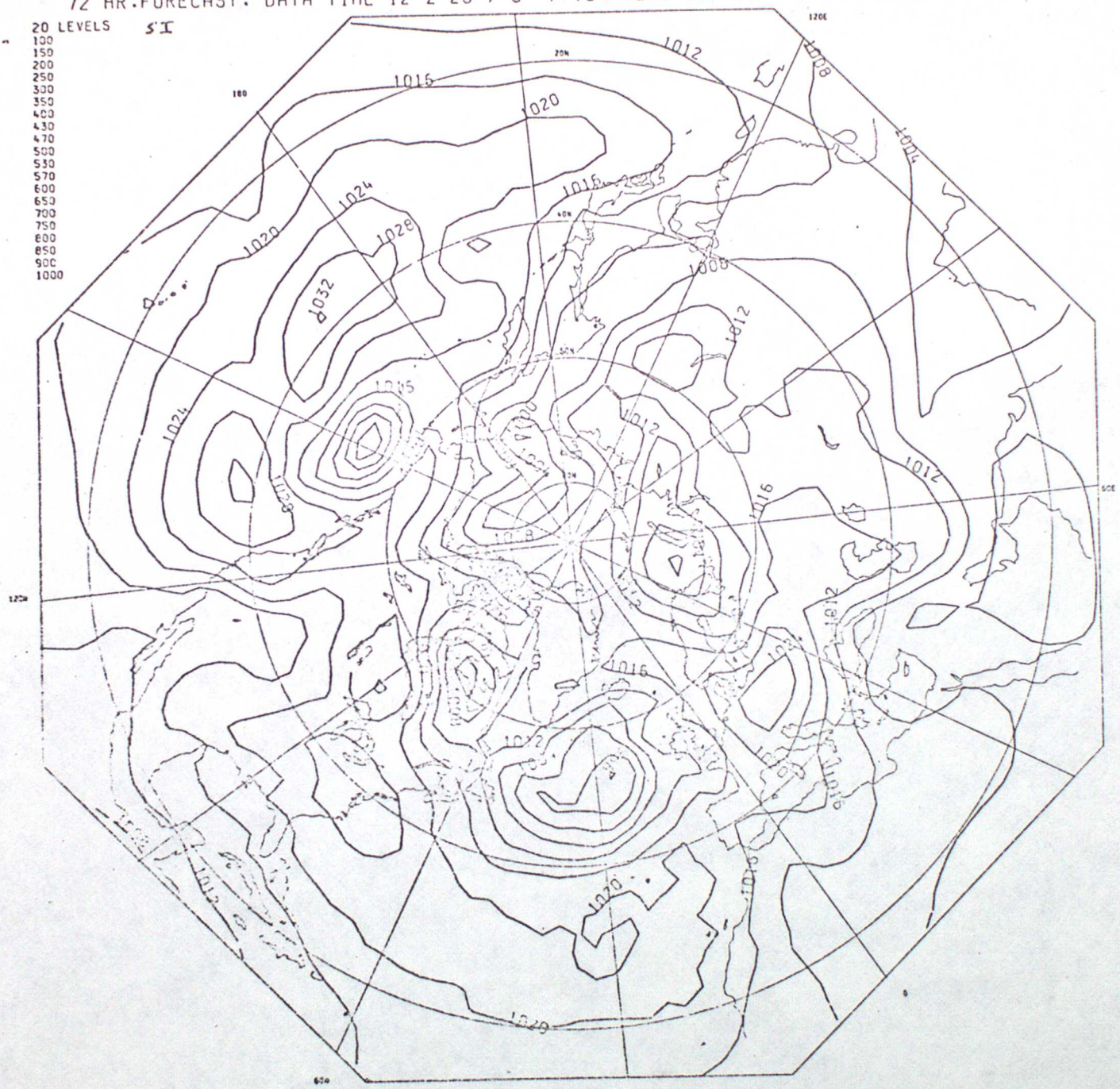


300 KM OCTAGON

6 LEVEL EXPLICIT

SURFACE PRESSURE FIELD

72 HR.FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76

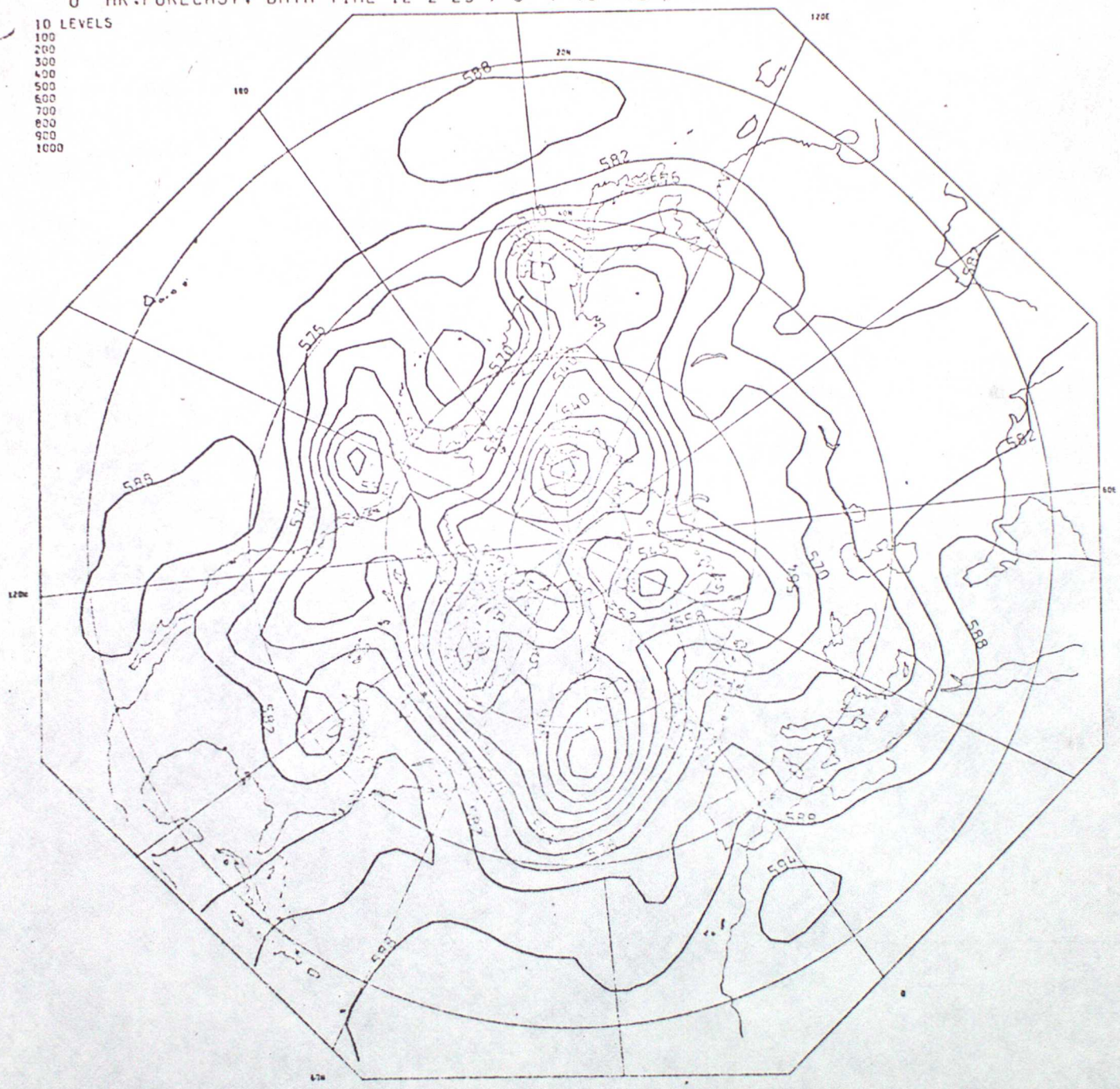


300 KM OCTAGON

20 LEVEL SEMI-IMPLICIT

500 MB HEIGHT FIELD

0 HR.FORECAST. DATA TIME 12 Z 23 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76



300 KM OCTAGON

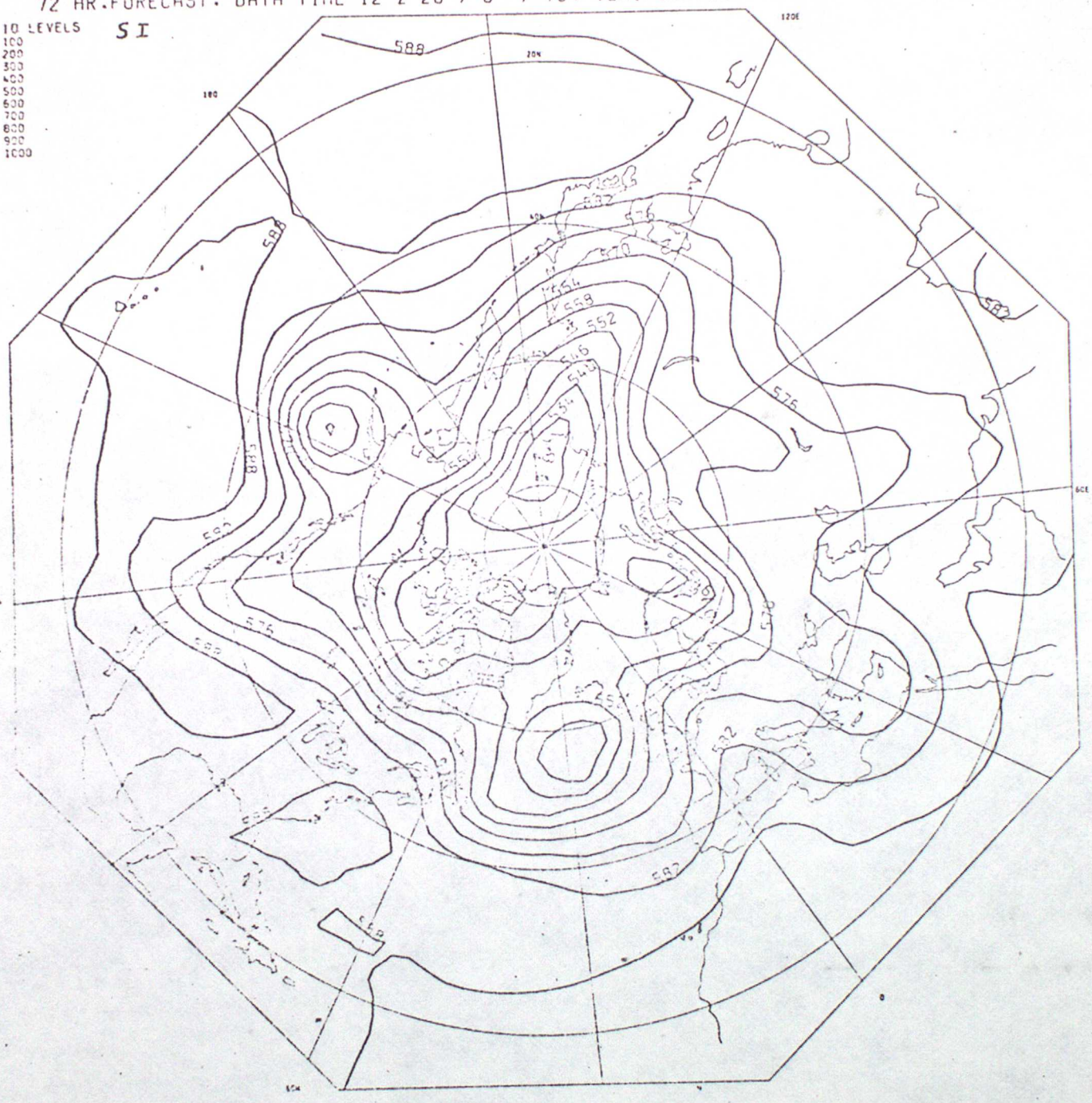
DAY 3 ANALYSIS

500 MB HEIGHT FIELD

72 HR.FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76

10 LEVELS SI

100
200
300
400
500
600
700
800
900
1000

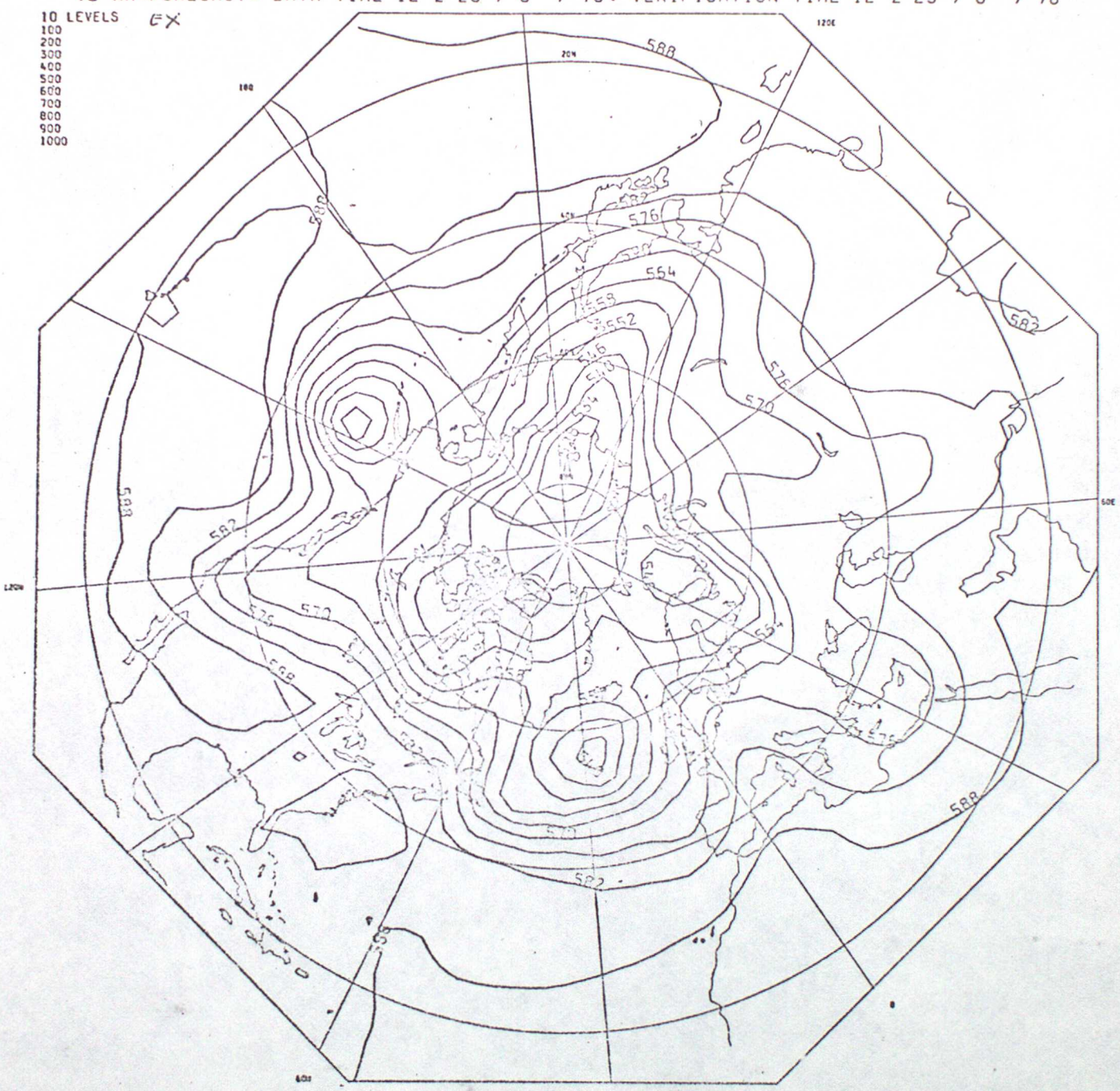


300 KM OCTAGON

10 LEVEL SEMI-IMPLICIT

500 MB HEIGHT FIELD

72 HR.FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76

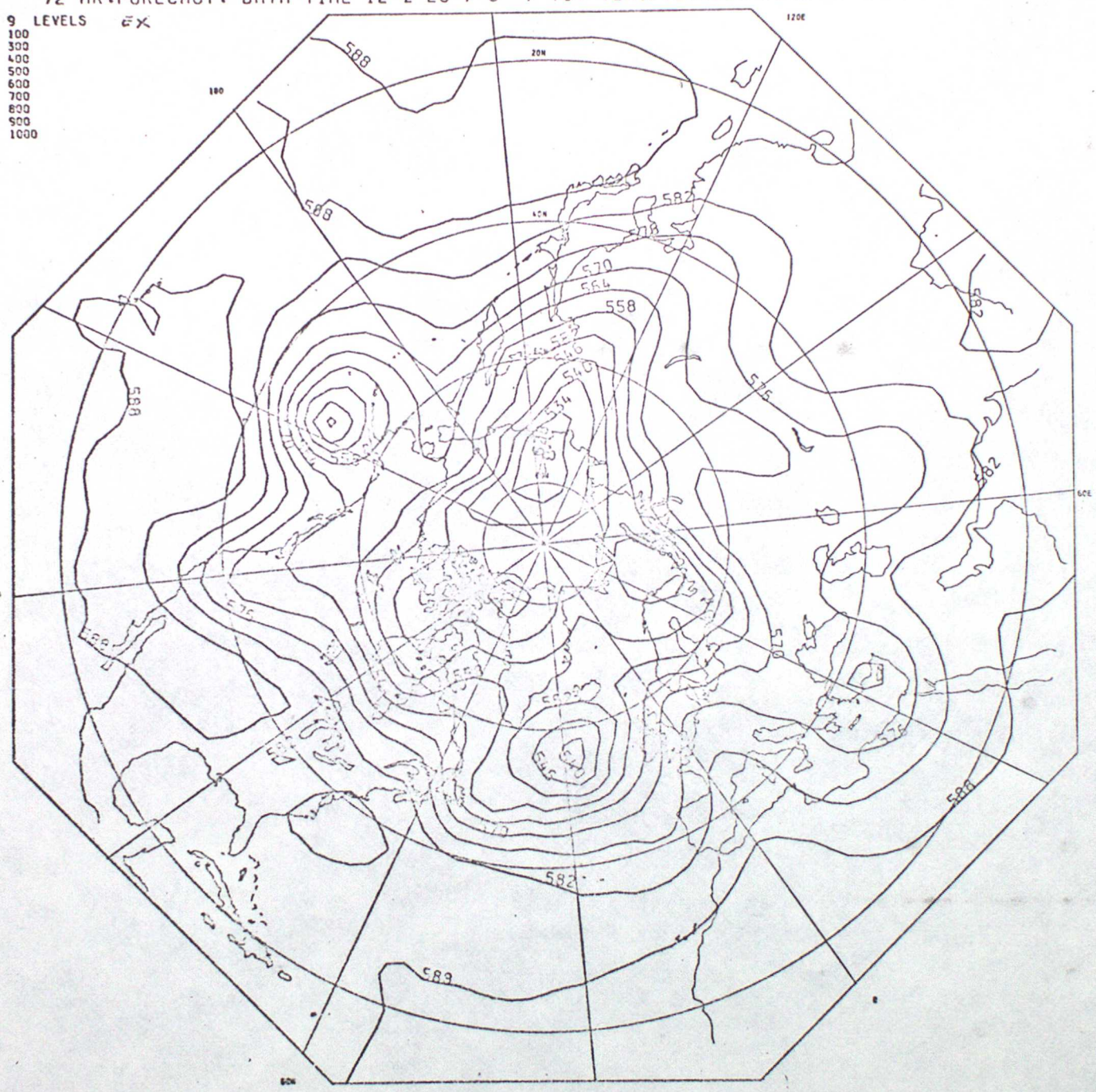


300 KM OCTAGON

10 LEVEL EXPLICIT

500 MB HEIGHT FIELD

72 HR.FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76



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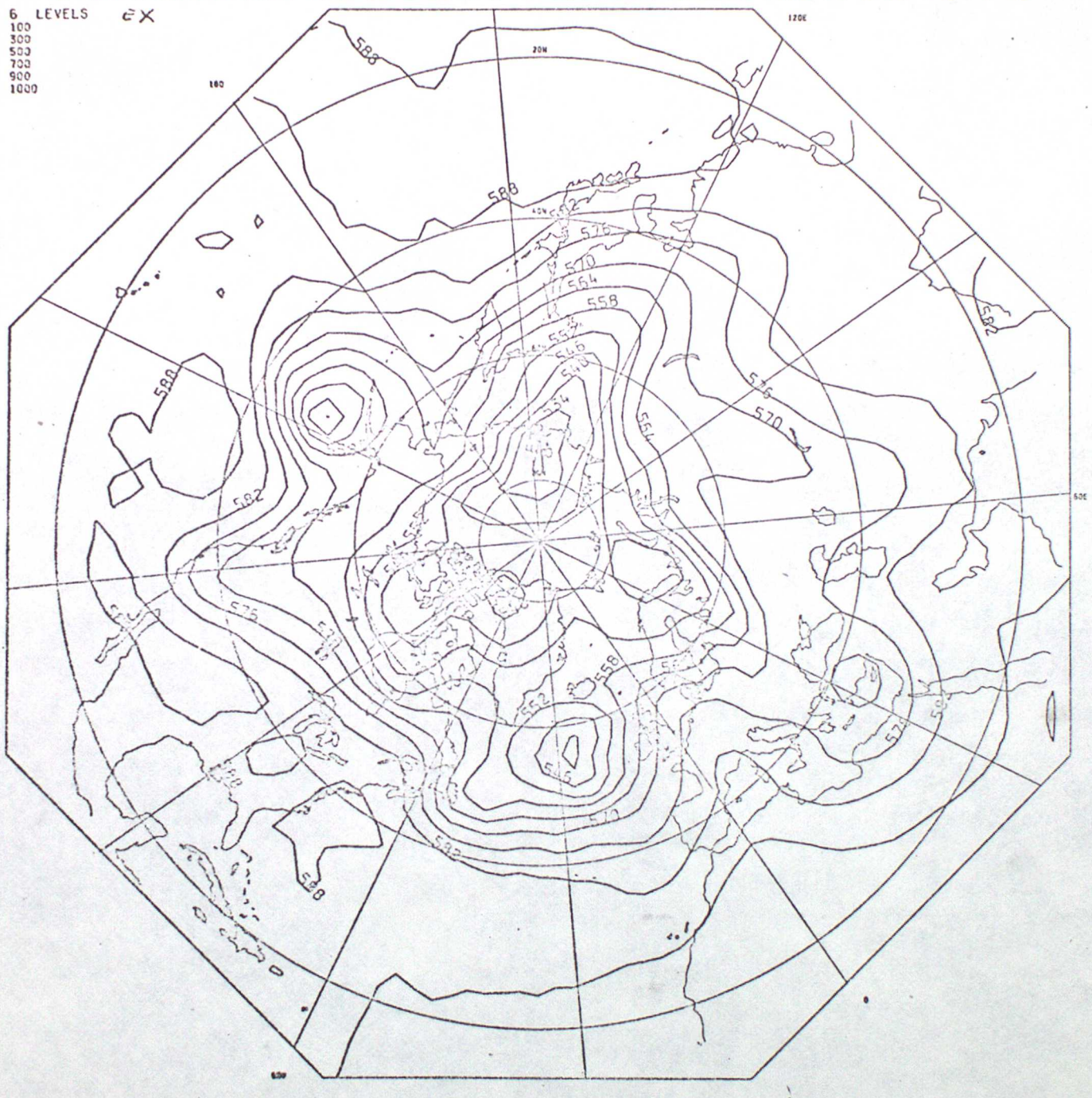
9 LEVEL EXPLICIT

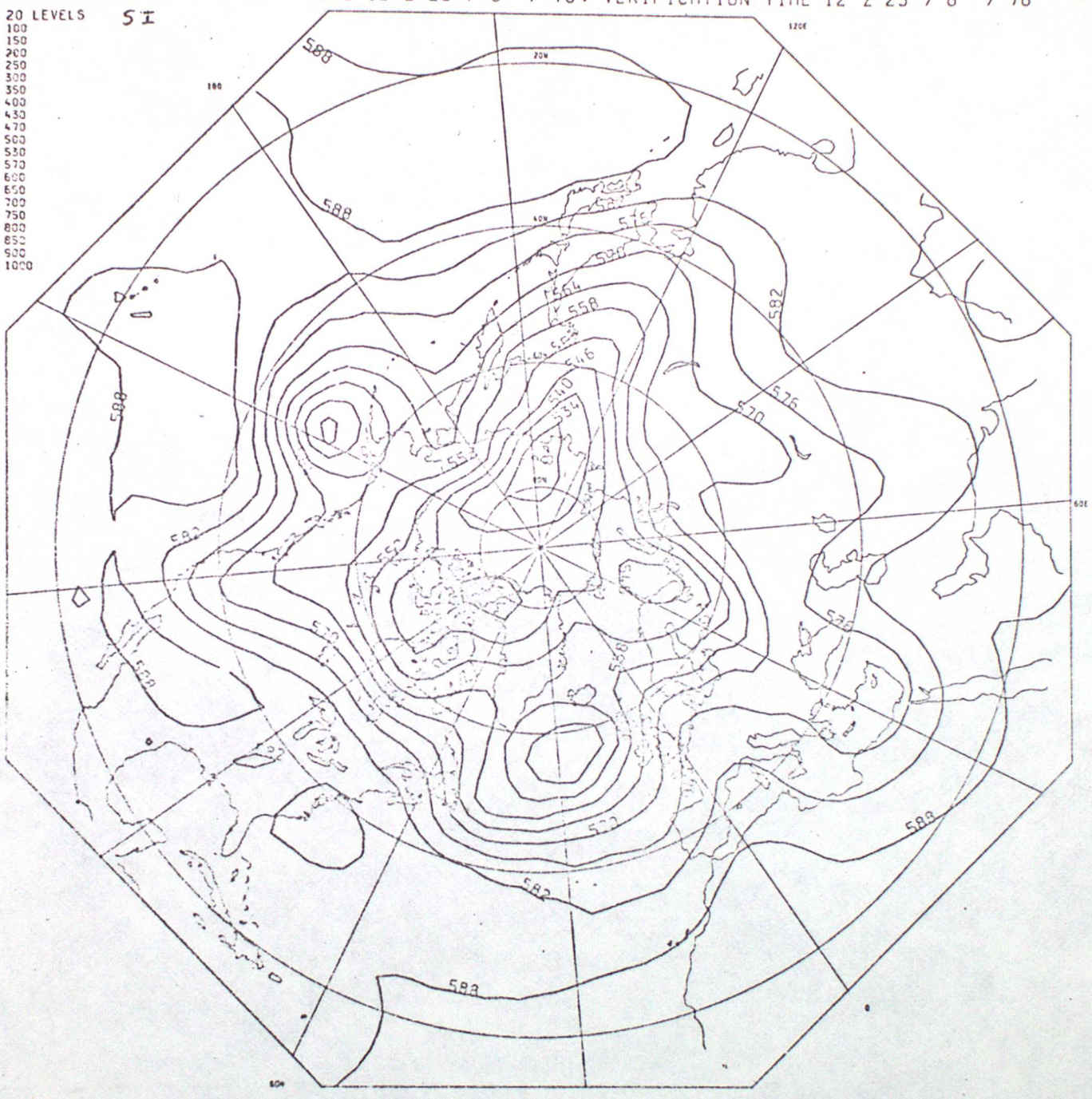
500 MB HEIGHT FIELD

72 HR.FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76



500 MB HEIGHT FIELD

72 HR. FORECAST. DATA TIME 12 Z 20 / 6 / 76. VERIFICATION TIME 12 Z 23 / 6 / 76



300 KM OCTAGON

20 LEVEL SEMI-IMPLICIT